

Hospital admissions, deaths and overall burden of disease attributable to alcohol consumption in Scotland



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Key points

This report provides an estimate of the number of patient admissions, deaths and overall burden of disease attributable to alcohol in Scotland.

Patients admitted to hospital due to alcohol consumption in 2015

- In 2015, a total of 41,161 adults aged 16 years and over were admitted to hospital at least once with a wholly or partially alcohol-attributable condition (6.4% of 644,574 total individuals admitted at least once in 2015).
- Men were twice as likely to be hospitalised with an alcohol-attributable condition in 2015 compared with women (8.8% and 4.3%, respectively).
- Of the adult patients hospitalised due to alcohol in 2015, more than one in four (27%) were admitted for an unintentional injury.

Deaths attributable to alcohol consumption in 2015

- There were an estimated 3,705 deaths attributable to alcohol consumption in 2015 among adults aged 16 years and over in Scotland. This equates to 6.5% of the total number of deaths (57,327).
- Men were almost twice as likely to die from an alcohol-attributable condition in 2015 compared with women (8.4% and 4.7%, respectively).
- More than one in four (28%) alcohol-attributable deaths were due to cancer.

Overall burden of disease attributable to alcohol consumption in 2015

- Alcohol consumption accounted for 8.0% of the burden of disease in Scotland in 2015 [104,573 out of a total 1,315,087 disease-adjusted life years (DALYs)].

Introduction

The impact of alcohol consumption in Scotland in terms of harms to health, as well as the wider impact on individuals, families, communities and the economy, is well documented.¹ In 2009, the Scottish Government published a comprehensive alcohol framework to tackle alcohol-attributable harm. The framework is multi-stranded and includes the Licensing Act, the Alcohol Act and Minimum Unit Pricing.¹

Understanding the impact that alcohol has on the overall burden of disease and death in society is an important step in prioritising policy and practice to reduce the harm alcohol causes to health in Scotland. The alcohol-attributable burden can be divided into conditions deemed wholly attributable to alcohol (i.e. where the cause of disease or death is, by definition, 100% attributable to alcohol) and those deemed partially attributable to alcohol (i.e. where alcohol consumption accounts for only a proportion of disease or deaths).

In 2009, a report presenting estimates of the proportion of hospital admissions and deaths attributable to alcohol consumption in Scotland, 'Alcohol-attributable mortality and morbidity: alcohol population attributable fractions for Scotland', was published.² Since then, the Scottish Burden of Disease, Injuries and Risk Factors study (SBoD) has sought to quantify mortality and morbidity more comprehensively by estimating the years of life lost through early death caused by disease and the years of healthy life lost through living with the consequences of disease.³

The aim of this study is to bridge the approach taken in the first Scottish report in 2009² and the SBoD study³ by revising estimates for patient admissions and deaths attributable to alcohol and incorporating, for the first time in Scotland using real data,^a an overall measure of the burden of disease attributable to alcohol consumption.

^a The Global Burden of Disease (GBD) study has published estimates of the burden of disease attributable to alcohol for Scotland, but these are partially based on synthetic data modelled from the level of economic and social development in the nation rather than actual health data.

Methods

A summary of the methods used is described below to aid interpretation of the results. Full details of the methods can be found in the supplementary appendix.

Conditions included in this study

A total of 20 wholly and 30 partially attributable conditions were included in this study based on a review on strength of causality undertaken by the most recent study on the alcohol-attributable burden of disease for England (2013).⁴ Conditions defined as wholly or partially attributable to alcohol consumption in this report and the related International Statistical Classification of Diseases and Related Health Problems 10th Revision (ICD-10) codes are summarised in **Table 1**. The wholly attributable conditions listed here include additional conditions over and above the revised definition of alcohol-specific deaths from the Office for National Statistics (ONS) as this analysis was completed prior to its release. See the supplementary appendix for more information.

Table 1: Conditions wholly and partially attributable to alcohol consumption.

Condition	ICD-10 code(s)
Wholly attributable conditions	
Accidental poisoning by and exposure to alcohol	X45
Alcohol-induced acute pancreatitis	K85.2
Alcohol-induced chronic pancreatitis	K86.0
Alcohol-induced pseudo-Cushing's syndrome	E24.4
Alcoholic cardiomyopathy	I42.6
Alcoholic gastritis	K29.2
Alcoholic liver disease	K70
Alcoholic myopathy	G72.1
Alcoholic polyneuropathy	G62.1
Degeneration of nervous system due to alcohol	G31.2
Ethanol poisoning	T51.0
Evidence of alcohol involvement determined by blood alcohol level	Y90

Condition	ICD-10 code(s)
Evidence of alcohol involvement determined by level of intoxication	Y91
Excess alcohol blood levels	R78.0
Fetal alcohol syndrome (dysmorphic)	Q86.0
Intentional self-poisoning by and exposure to alcohol	X65
Mental and behavioural disorders due to use of alcohol	F10 ^b
Methanol poisoning	T51.1
Poisoning by and exposure to alcohol, undetermined intent	Y15
Toxic effect of alcohol, unspecified	T51.9
Partially attributable chronic conditions	
Infectious and parasitic diseases	
Tuberculosis	A15–A19
Malignant neoplasms	
Breast	C50
Colorectal	C18–C20
Larynx	C32
Lip, oral cavity and pharynx	C00–C14
Liver and intrahepatic bile ducts	C22
Oesophagus	C15
Diabetes mellitus	
Diabetes mellitus (type 2)	E11
Diseases of the nervous system	
Epilepsy and status epilepticus	G40–G41
Cardiovascular disease	
Cardiac arrhythmias	I47–I48
Haemorrhagic stroke	I60–I62, I69.0–I69.2
Hypertensive diseases	I10–I15
Ischaemic/coronary heart disease	I20–I25
Ischaemic stroke	I63–I66, I69.3–I69.4
Respiratory infections	

^b This grouping includes several disorders that differ in severity and clinical form but that are all attributable to alcohol: acute intoxication, harmful use, dependence syndrome, withdrawal state (including with delirium), psychotic disorder, amnesic syndrome, residual and late-onset psychotic disorder, and other and unspecified mental and behavioural disorders.

Condition	ICD-10 code(s)
Pneumonia	J10.0, J11.0, J12–J15, J18
Digestive disease	
Acute and chronic pancreatitis	K85, K86.1
Cholelithiasis (gallstones)	K80
Oesophageal varices	I85
Unspecified liver disease	K73, K74
Pregnancy and childbirth	
Low birth weight	†
Spontaneous abortion	O03
Partially attributable acute condition	ICD-10 codes
Unintentional injuries	
Drowning	W65–W74
Fall injuries	W00–W19
Fire injuries	X00–X09
Road/pedestrian traffic accidents	††
Poisoning	X40–X49
Other unintentional injuries	†††
Intentional injuries	
Assault	X85–Y09
Event of undetermined intent	Y10–Y34
Intentional self-harm	X60–X84

Notes: Codes and conditions taken from Jones L, Bellis M. Updating England-specific alcohol-attributable fractions. Centre for Public Health Liverpool John Moores University; 2014.⁴

† Live singleton births < 2500g in 2015.

†† V021–V029, V031–V039, V041–V049, V092, V093, V123–V129, V133–V139, V143–V149, V194–V196, V203–V209, V213–V219, V223–V229, V233–V239, V243–V249, V253–V259, V263–V269, V273–V279, V283–V289, V294–V299, V304–V309, V314–V319, V324–V329, V334–V339, V344–V349, V354–V359, V364–V369, V374–V379, V384–V389, V394–V399, V404–V409, V414–V419, V424–V429, V434–V439, V444–V449, V454–V459, V464–V469, V474–V479, V484–V489, V494–V499, V504–V509, V514–V519, V524–V529, V534–V539, V544–V549, V554–V559, V564–V569, V574–V579, V584–V589, V594–V599, V604–V609, V614–V619, V624–V629, V634–V639, V644–V649, V654–V659, V664–V669, V674–V679, V684–V689, V694–V699, V704–V709, V714–V719, V724–V729, V734–V739, V744–V749, V754–V759, V764–V769, V774–V779, V784–V789, V794–V799, V803–V805, V811, V821, V830–V833, V840–V843, V850–V853, V860–V863, V870–V878, V892.

††† V01, V090, V091, V099, V100–V109, V110–V119, V120–122, V130–132, V140–V142, V150–V159, V160–V169, V170–V179, V180–V189, V191–V193, V20–V28: 0.1–0.2; V290–V293, V30–V38: 0.1–0.2; V390–V393, V40–V48: 0.1–0.2; V490–V493, V50–V58: 0.1–0.2; V590–V593, V60–V68: 0.1–0.2; V690–V693, V70–V78: 0.1–0.2; V790–V793, V800, V801, V806–V809, V810, V812–V819, V820, V822–V829, V834–V839, V844–V849, V854–V859, V864–V869, V879, V88, V890, V891, V893–V899, V90–V94, V95–V97, V98–V99, W20–W52, W75–W84, W85–W99, X10–X19, X20–X29, X30–X33, X50–X57, X58, X59, Y40–Y84, Y85, Y86, Y88, Y89.

Estimating alcohol consumption

Self-reported data on mean weekly alcohol consumption (units) from the Scottish Health Survey 2015⁵ were used to derive measures of daily alcohol consumption in grams/day. This was done by multiplying the mean weekly consumption in units by 8 then dividing by 7; one unit is equivalent to 8 grams of pure alcohol. It is widely acknowledged that health surveys using self-reported data underestimate alcohol consumption.^{6,7} In this study we used an established approach to triangulate self-reported alcohol consumption estimates with alcohol sales data to adjust alcohol consumption estimates to a more realistic level.^{4,8} The effect that this has had on alcohol consumption estimates is shown in **Figure 1** for men and **Figure 2** for women. For more information on the method used to apply the adjustment see the supplementary appendix.

Figure 1: Mean daily alcohol consumption of adult men in Scotland 2015 (original and adjusted consumption levels), by age group.

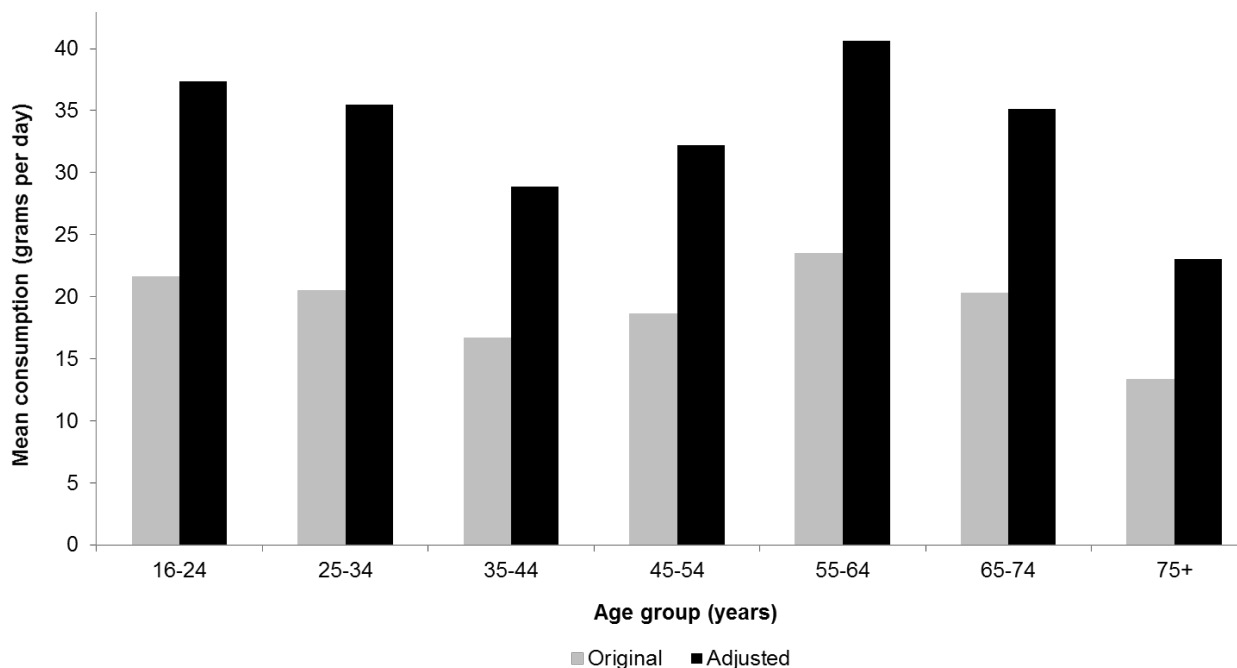
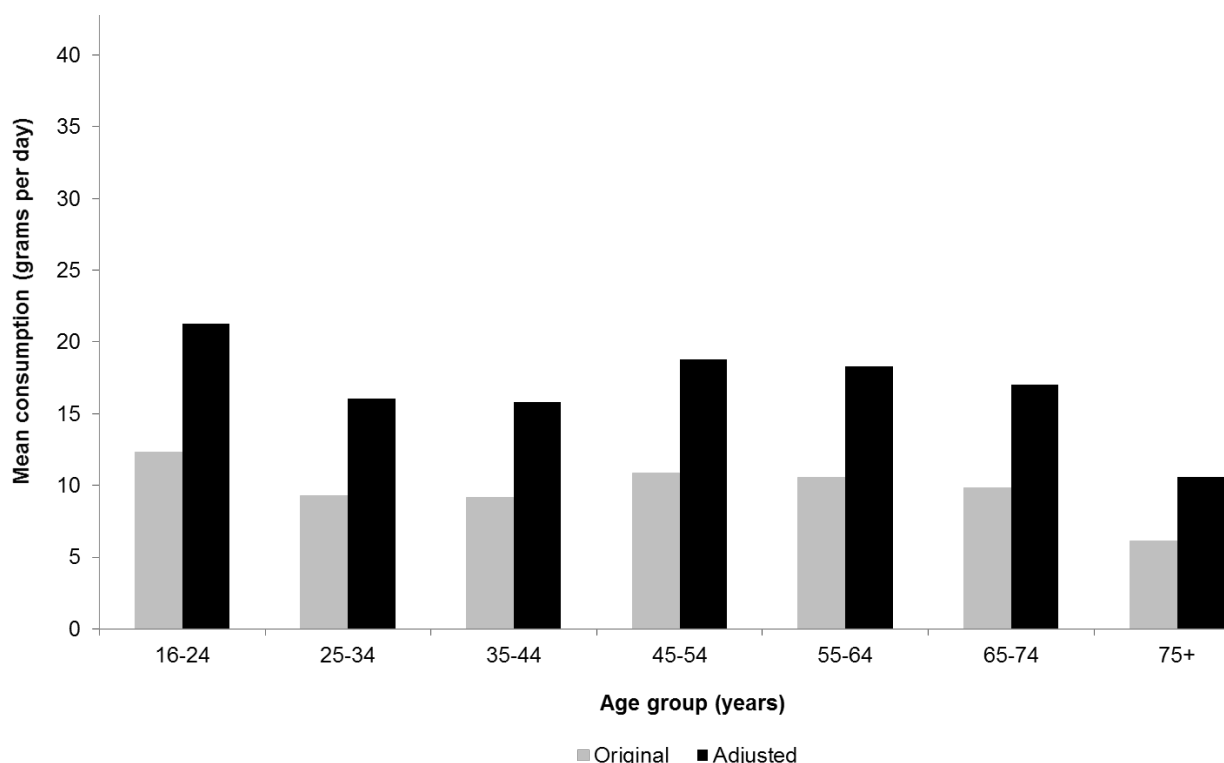


Figure 2: Mean daily alcohol consumption of adult women in Scotland 2015 (original and adjusted consumption levels), by age group.



Estimating relative risks

The relative risk (RR) function is the relationship between alcohol consumption (measured continuously and defined from 0g to 150g of pure alcohol per day) and each health outcome, as estimated from relevant systematic reviews and expressed as mathematical formulae (see the supplementary appendix). For the majority of chronic conditions included in this study, two RR functions were used: the RR function for a one-unit increase in alcohol consumption among current drinkers at 0.1g gradations of consumption up to 150g compared with life-time abstainers; and the RR for former drinkers compared with lifetime abstainers.

Chronic conditions: current drinkers compared with lifetime abstainers

The RR for developing a chronic health condition in relation to alcohol consumption was derived from the work of Jones and Bellis⁴ who undertook a systematic review to establish the RR functions for each partially attributable chronic health condition. The authors

acknowledged that the risk of developing a condition may be different to the risk of dying from the same condition. To account for this, separate RR functions for mortality and morbidity were reported where possible, i.e. for stroke and liver disease. For the remaining health conditions the reported RR function was used as a composite risk estimate to calculate a single alcohol-attributable fraction for both mortality and morbidity combined for each health outcome. We have followed the same approach in this study. The RR functions reported by Jones and Bellis⁴ were superseded in cases where a review by Rehm et al.⁹ provided revised estimates for the risks of alcohol-attributable death from several chronic conditions^c based on more recent evidence.⁴ See the supplementary appendix for RR sources.

Chronic conditions: former drinkers compared with lifetime abstainers

The RR function for former drinkers versus lifetime abstainers was obtained from the work of Rehm et al.⁹ The sources for these RRs are available from the supplementary appendix.

Acute conditions

RRs were not obtained for acute injuries in this study as robust data on frequency of binge drinking in Scotland were not available. This meant that it was not possible to estimate alcohol-attributable fractions for acute injuries using the data available. Instead, we reported estimates directly from the Global Burden of Disease for 2015.¹⁰

Calculation of alcohol-attributable fractions

A total of 20 conditions were defined as being wholly attributable to alcohol in this study. For the remaining conditions, however, alcohol was deemed the cause for only a proportion of cases. The measure that quantifies the contribution of alcohol to the development of a health condition in the population is the alcohol-attributable fraction (AAF). It can be defined as:

^c Revised RR estimates were available for tuberculosis, all cancers listed in this study, hypertensive diseases, acute and chronic pancreatitis and low birth weight.

‘the proportional reduction in population disease or mortality that would occur if exposure to a risk factor were reduced to an alternative ideal exposure scenario’¹¹

The ideal exposure scenario used in this study was a population who had never drunk alcohol (lifetime abstainer).

Our estimates were calculated using a Microsoft Excel model developed by Kelly¹² and modified by Jones and Bellis⁴ which allowed for a discrete approximation of this approach.

Formula 2 is an approximation of the continuous approach shown in **Formula 1**. See the supplementary appendix for full details.

Formula 1

$$AAF = \frac{P_{abs} + P_{former}RR_{former} + \int_0^{150} P_{current}(x)RR_{current}(x)dx - 1}{P_{abs} + P_{former}RR_{former} + \int_0^{150} P_{current}(x)RR_{current}(x)dx}$$

- **P_{abs}** represents lifetime abstainers.
- **P_{former}** is the prevalence of former drinkers.
- **RR_{former}** is the RR for former drinkers.
- **P_{current}** is the prevalence of current drinkers who consume an average daily amount (x) of alcohol.
- **RR_{current}** is the RR given an average daily consumption of x grams.

The formula used in this study reduced this to:

Formula 2

$$AAF = \frac{\sum P_i RR_i - 1}{\sum P_i RR_i}$$

- **P_i** is the proportion of adults in each exposure stratum i from 0.1g to 150g of alcohol per day.
- **RR_i** is the RR for each exposure stratum i from 0.1g to 150g of alcohol per day.

For this update we incorporated certain methodological developments used in the 2013 Jones and Bellis update for England to calculate AAFs.⁴ This allowed for alcohol

consumption to be treated as a continuous variable and for the reference category of 'zero alcohol consumption' to be disaggregated further into lifetime abstainers. Alcohol consumption was capped at 150g per day in accordance with the international literature.⁴

Estimating the impact of alcohol consumption on population health

Three key measures were used to estimate the impact of alcohol consumption on population health in Scotland in 2015:

- 1 The number of patients admitted to hospital at least once in 2015 for a condition that could be explained either wholly or partially by alcohol consumption.^d
- 2 The number of deaths in 2015 in adults aged 16 years and over that could be explained either wholly or partially by alcohol consumption.^e
- 3 The overall burden of disease in Scotland in 2015 that could be explained by alcohol consumption (i.e. a composite measure of the potential years of life lost through early death from alcohol consumption and the number of years of healthy life lost through disability as a result of living with an alcohol-attributable condition). This measure is called the disability-adjusted life year (DALY) and quantifies the overall burden of mortality and morbidity arising from disease. DALY estimates include adults aged 15 years of age due to minor differences in the age-bandings available for these data.^f

The calculated AAFs were multiplied in turn by each of the above three measures to give the number of patients admitted to hospital due to alcohol, alcohol-attributable deaths and the overall burden of disease (DALYs) attributable to alcohol in 2015.

Note that the DALY estimates are based on a disease classification which does not differentiate between wholly and partially attributable conditions. All diseases have been treated as partially attributable with the exception of alcohol dependence.

^d Data were extracted from the Scottish Morbidity Record 01 (SMR01) general acute inpatients and day cases for calendar year 2015. See the supplementary appendix.

^e Data were extracted from the SMR01 general acute inpatients and day cases for calendar year 2015. See the supplementary appendix.

^f Data source was the Scottish Burden of Disease, Injuries and Risk Factors study section of the ScotPHO website.¹⁸ See the supplementary appendix.

Further information on the three measures and the disease classification used to estimate DALYs can be found in the supplementary appendix.

The results presented in this report are not directly comparable to the first report on alcohol-attributable mortality and morbidity in Scotland by Grant et al.² because of key methodological differences in how alcohol consumption was estimated, how the relationship between alcohol and each cause of death/disease was modelled, and also changes to many of the RR functions previously applied. Key differences in the methods are detailed in the supplementary appendix. To aid understanding of changes over time, the current method was retrospectively applied to data from 2003.

Results

Alcohol-attributable fractions

By definition, the AAFs for all 20 wholly attributable conditions in both men and women was 1 (or 100%). For the partially attributable conditions, and based on adjusted alcohol consumption estimates, the largest AAFs for men and women of all ages were for death from unspecified liver disease (0.72 for men and 0.76 for women). Estimates were lower when calculated using the original alcohol consumption estimates (0.54 for men and 0.68 for women). All results presented in **Figures 3** and **4** are based on the adjusted alcohol consumption estimates.

In general, AAFs were higher for men than women (for 22 out of the 32 AAFs calculated for both men and women), reflecting the different alcohol consumption levels between men and women.

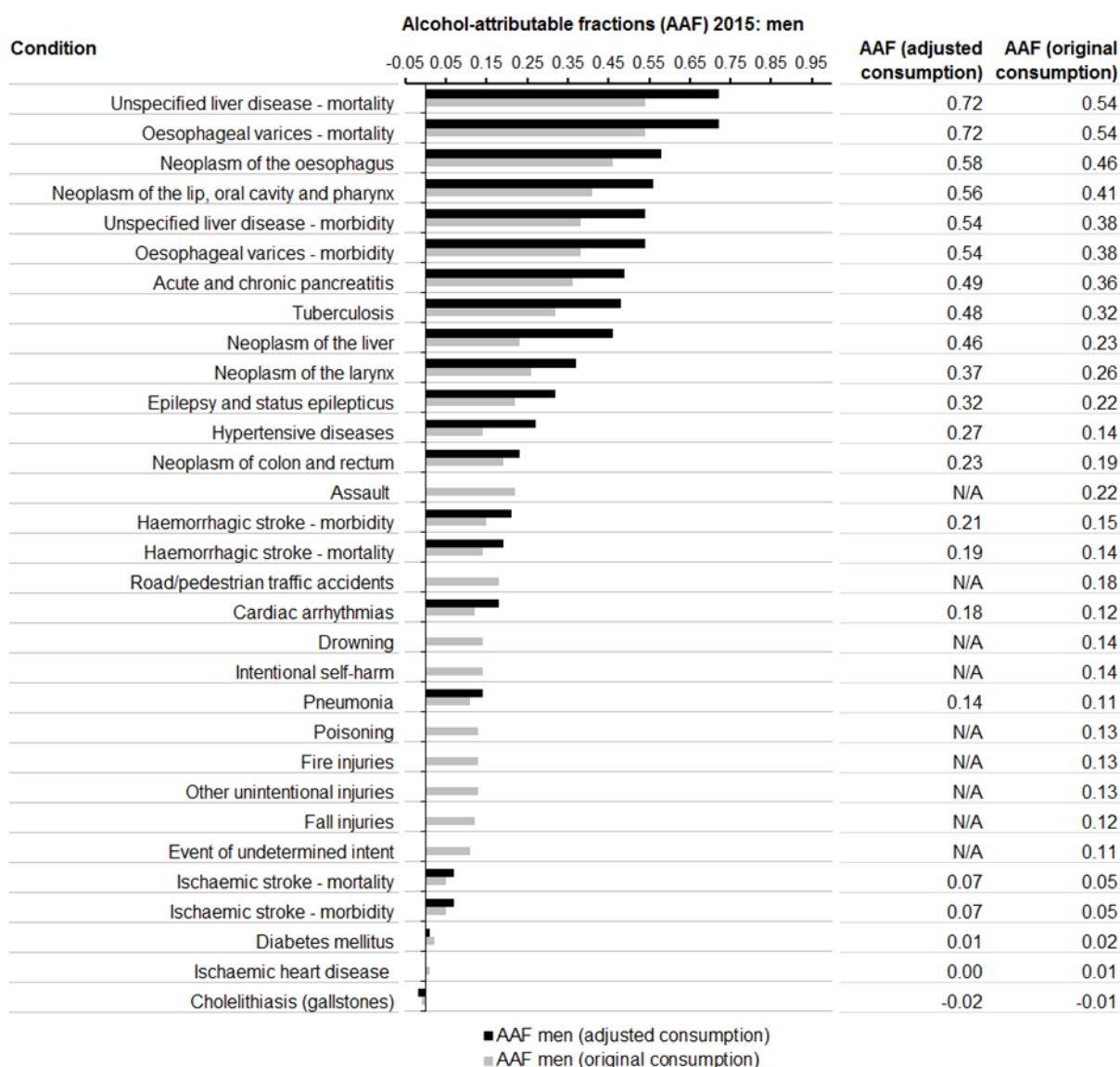
For cancers, a combined AAF was calculated for hospitalisation and death, as one composite RR was used. The highest AAF for cancer in both men and women was for death or hospitalisation due to neoplasm of the oesophagus (0.58 for men and 0.41 for women). The ranking of cancer by AAF was the same for both sexes [neoplasm of the oesophagus; neoplasm of the lip, oral cavity and pharynx; neoplasm of the liver and hepatic bile ducts; neoplasm of the larynx; neoplasm of the breast (included here for women only); and neoplasm of the colon and rectum].

The picture for cardiovascular disease by sex was mixed. For men, the highest AAF was for hospitalisation or death due to hypertensive diseases (0.27) whereas for women the highest AAF was for death from haemorrhagic stroke (0.23) followed by hospitalisation or death due to hypertensive disease (0.10).

Of the digestive diseases, death from unspecified liver disease had the highest AAF for both men and women (0.72 and 0.76, respectively) followed by hospitalisation for unspecified liver disease (0.54 and 0.63, respectively). The highest AAF among the alcohol-attributable acute injuries for both men and women was for death from assault

(0.22 and 0.19, respectively). AAFs are reported for all conditions by age and sex in the supplementary appendix.

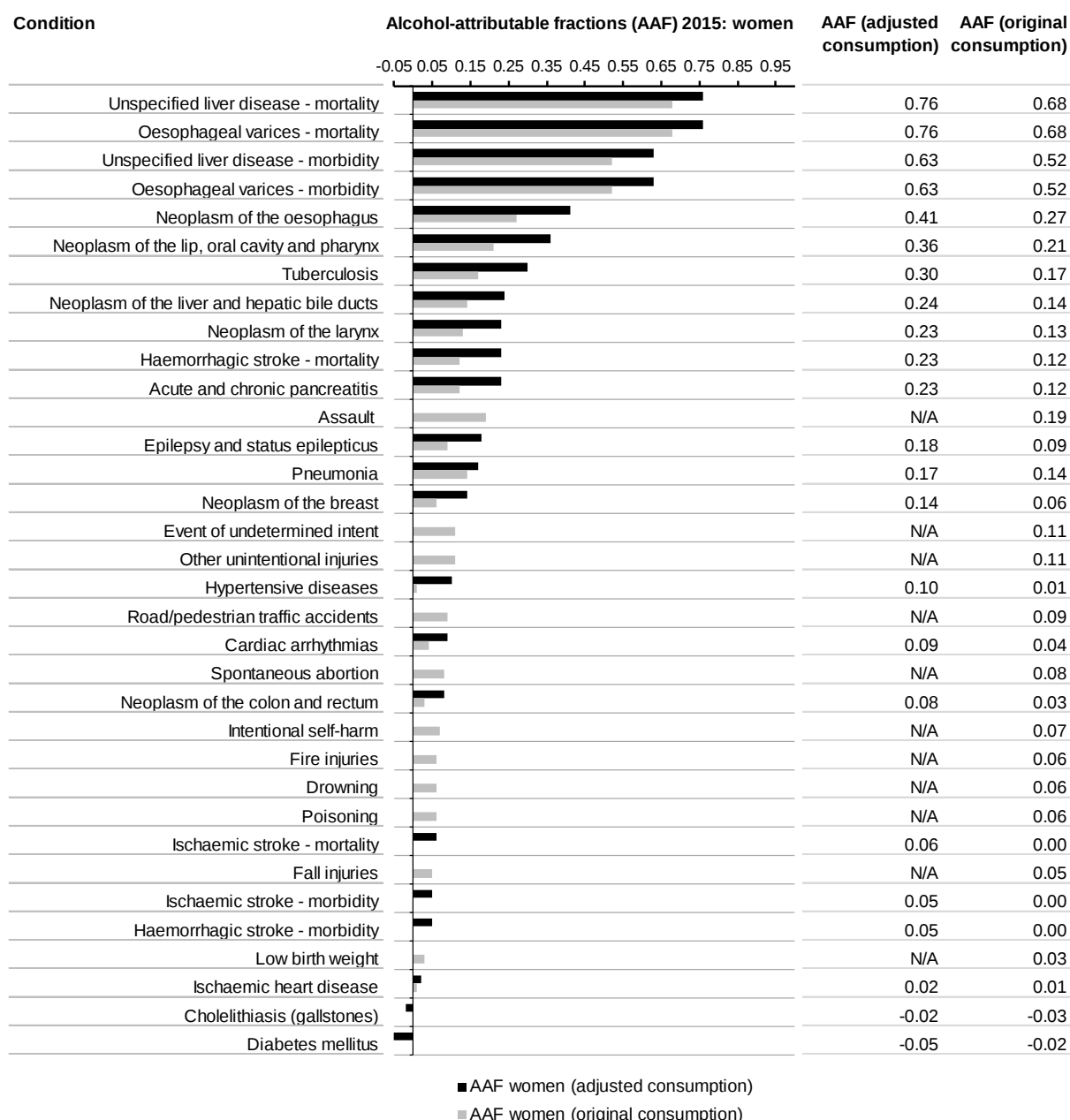
Figure 3: AAFs for partially attributable conditions in 2015: based on adjusted and original alcohol consumption, men.



Note:

- Where mortality or morbidity is not indicated after a health outcome, the AAF is a composite AAF for both of these.
- Chart style template adapted from work licensed under a Creative Common License Attribution <http://creativecommons.org/licenses/by/3.0>
- Adjusted AAF estimates were not available for injuries as these estimates were reported directly from the GBD 2015 for Scotland. The GBD method did not incorporate the adjustment for alcohol consumption described for chronic conditions in this study.

Figure 4: AAFs for partially attributable conditions in 2015: based on adjusted and original alcohol consumption, women.



Note

- Where mortality or morbidity is not indicated after a health outcome, the AAF is a composite AAF for both of these.
- Chart style adapted from work licensed under a Creative Common License Attribution <http://creativecommons.org/licenses/by/3.0>
- Adjusted AAF estimates were not available for injuries as these estimates were reported directly from the GBD 2015 for Scotland. The GBD method did not incorporate the adjustment for alcohol consumption described for chronic conditions in this study.
- Original alcohol consumption estimates were used in the calculation of AAFs for pregnant women. In addition, 49% of female current drinkers were reclassified as former drinkers to account for changes in alcohol consumption during pregnancy. See the supplementary appendix.

The results from this study are not directly comparable to the original report from 2009² due to changes in the methodological approach applied. When the current methods were retrospectively applied to the 2003 alcohol consumption data we found that AAFs for chronic partially attributable conditions were broadly lower in 2015 than they were in 2003. See the supplementary appendix for 2003 AAF estimates.

Patients hospitalised with an alcohol-attributable condition

In 2015, a total of 41,161 adults aged 16 years and over were admitted to hospital at least once with a wholly or partially alcohol-attributable condition (6.4% of 644,574 total individuals admitted at least once in 2015).

Men were twice as likely to be hospitalised with an alcohol-attributable condition in 2015 compared with women (8.8% and 4.3%, respectively).

Relative to the total number of male hospital patients in each age group, alcohol-attributable hospitalisations were highest in men aged 16–54 years of age with almost one in 10 male patients admitted to hospital due to an alcohol-attributable condition at least once in 2015 (**Table 2**). The proportion was lower in older age groups with only 7.3% of male hospital patients aged 75 years and over having at least one admission attributable to alcohol. The highest absolute number of male hospital patients admitted with an alcohol-attributable condition was in those aged 55–64 years (4,987 male patients).

In relative terms, the proportion of female patients hospitalised with an alcohol-attributable condition fluctuated with age: the highest for those aged 45–54 years with around 5% of female patients admitted to hospital at least once in 2015. The highest actual number of women admitted was in those aged 75 years and over (3,529 patients admitted).

Table 2: Number and percentage of patients admitted to hospital with an alcohol-attributable condition, and percentage by age group and sex.

Age (years)	Men <i>N</i> (%) of patients admitted with an alcohol-attributable condition	Men Total male patients	Women <i>N</i> (%) of patients admitted with an alcohol-attributable condition	Women Total female patients	All <i>N</i> (%) of patients admitted with an alcohol-attributable condition	All Total patients
16–24	1,790 (10.0%)	17,902	1,179 (4.5%)	26,439	2,969 (6.7%)	44,341
25–34	2,419 (9.9%)	24,397	1,251 (3.6%)	34,785	3,670 (6.2%)	59,182
35–44	2,867 (9.9%)	28,817	1,678 (4.6%)	36,163	4,545 (7.0%)	64,980
45–54	4,318 (9.7%)	44,461	2,571 (4.9%)	52,763	6,889 (7.1%)	97,224
55–64	4,987 (9.3%)	53,835	2,560 (4.7%)	54,483	7,547 (7.0%)	108,318
65–74	4,898 (8.2%)	59,880	2,483 (4.1%)	59,901	7,381 (6.2%)	119,781
75+	4,631 (7.3%)	63,871	3,529 (4.1%)	86,877	8,160 (5.4%)	150,748
Total	25,911 (8.8%)	293,163	15,251 (4.3%)	351,411	41,161 (6.4%)	644,574

Note: Total patients defined as the total number of patients admitted at least once in 2015. Individual values may not sum to total due to rounding.

Unintentional injuries accounted for the largest number of male patients admitted to hospital with an alcohol-attributable condition (6,307 male patients admitted or 2.2% of all men admitted to hospital in 2015; **Figure 5**) and the largest number of female patients (4,761 patients admitted or 1.4% of all women admitted to hospital in 2015; **Figure 6**).⁹ See the supplementary appendix for a full breakdown of hospital admissions by age group and sex.

⁹ The total for each disease grouping in Figures 5 and 6 may not sum to the total of the conditions included within it due to rounding. The total for digestive diseases may not equal the sum total of the individual conditions within this grouping. This is due to the inverse relationship between alcohol consumption and gallstones (not shown) resulting in a reduction of admissions or deaths respectively. See Figures 3 and 4.

Figure 5: Men admitted to hospital due to alcohol, 2015

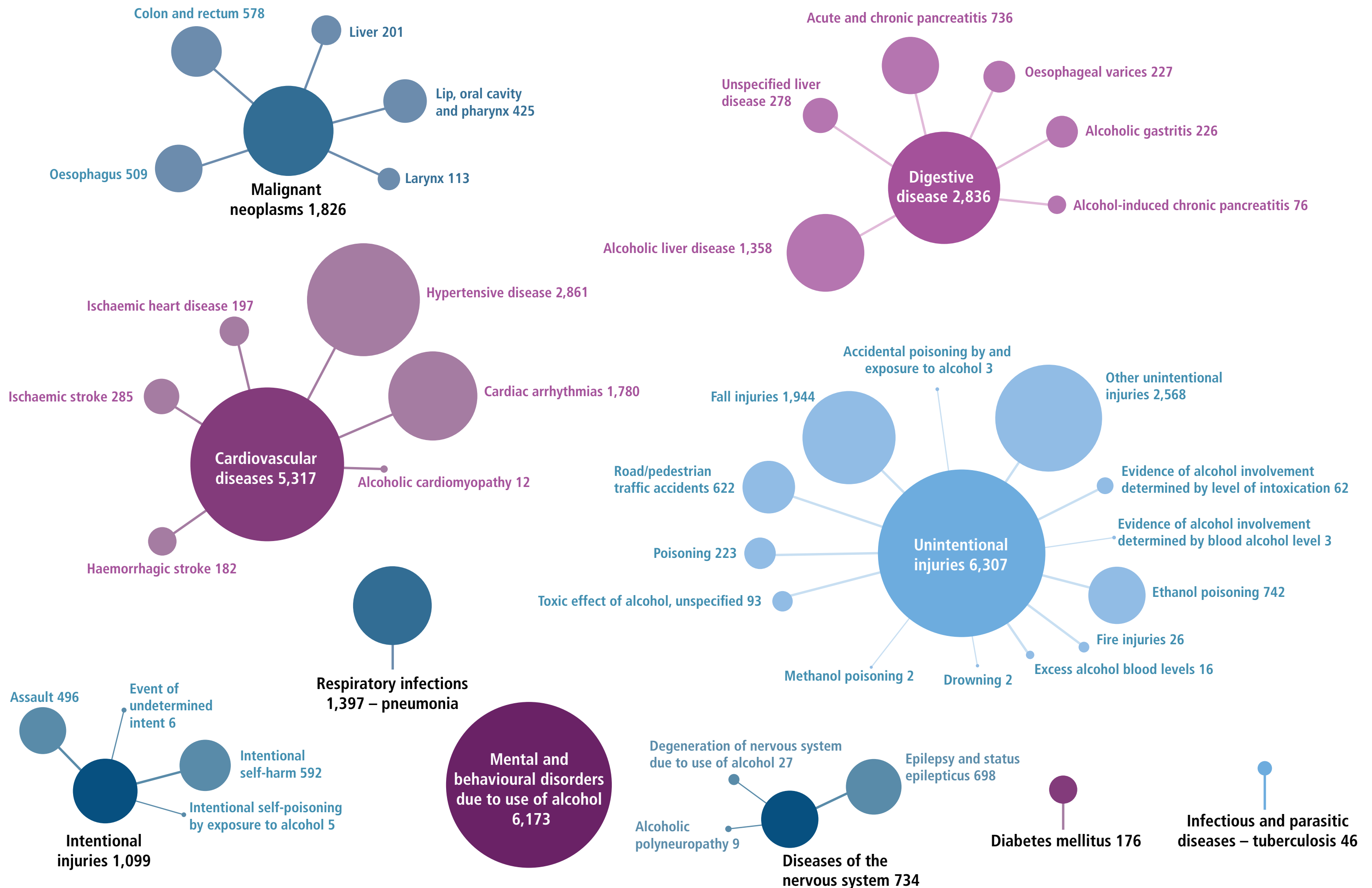
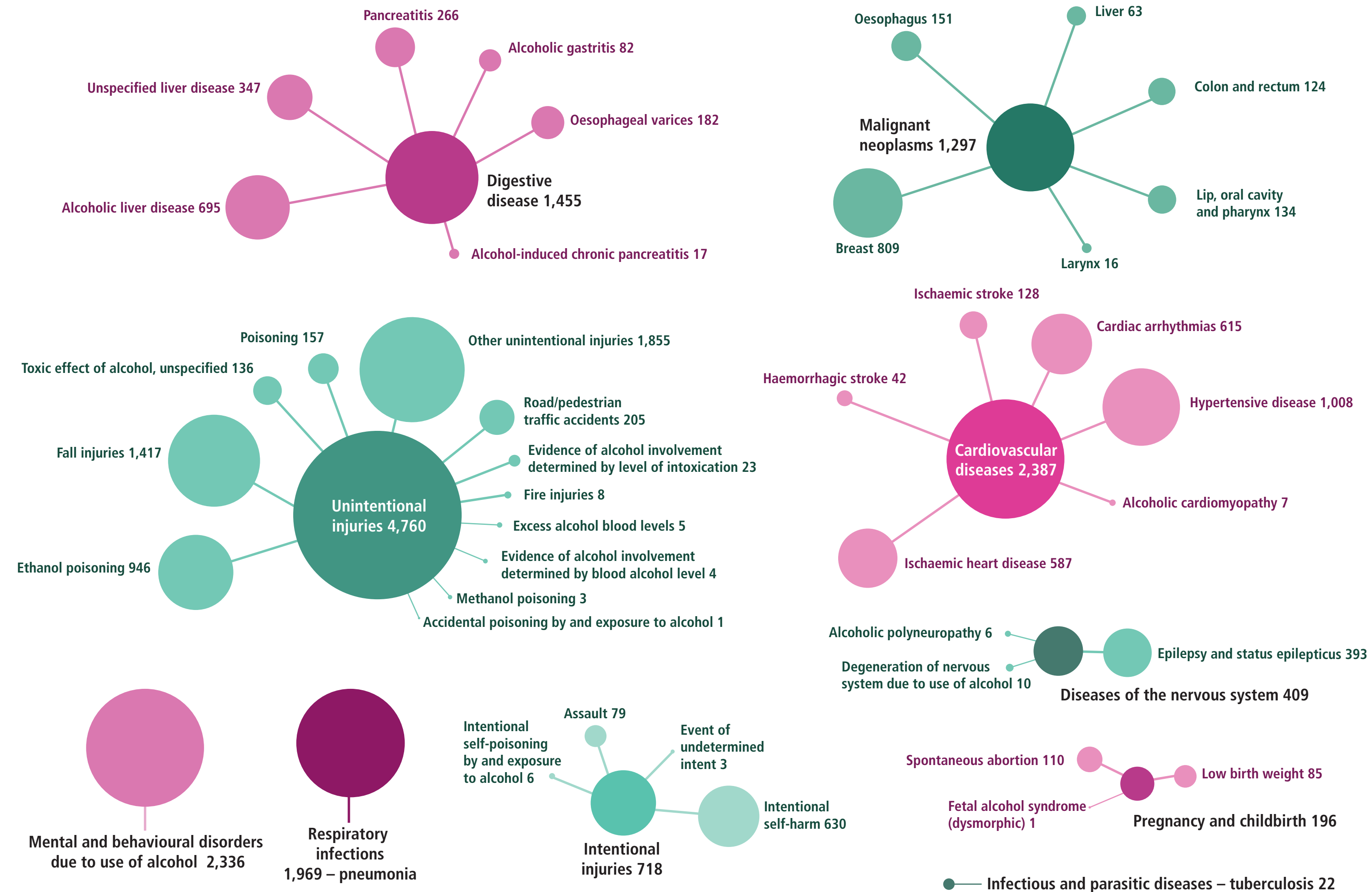


Figure 6: Women admitted to hospital due to alcohol, 2015



The highest percentage of alcohol-attributable hospitalisations in men aged 16–74 years of age was for mental and behavioural disorders due to alcohol consumption. In men aged 75 years and over the highest number of patients were admitted for pneumonia (see **Table 3**).

For women, the highest percentage of alcohol-attributable hospitalisations in those aged 16–24 years was for intentional self-harm. In women aged 25–64 years the most common diagnosis was for mental and behavioural disorders due to alcohol. The most common alcohol-attributable condition in women aged 65 years and over was for pneumonia (see **Table 3**).

Deaths attributable to alcohol

There were an estimated 3,705 deaths attributable to alcohol consumption in 2015 among adults aged 16 years and over in Scotland. This equates to 6.5% of the total number of deaths (57,327).

Men were almost twice as likely to die from an alcohol-attributable condition in 2015 compared with women (8.4% and 4.7%, respectively). The proportion of deaths attributable to alcohol was highest in men aged between 16 and 54 years with around one in five deaths attributable to alcohol consumption in this age range (20.6%–22.1%). The absolute number of deaths in this age range, however, was among the lowest. As mortality increases with age, so does the absolute number of alcohol-attributable deaths (see **Table 4**).

Deaths attributable to alcohol consumption in women fluctuated with age, with the highest proportion of alcohol-attributable deaths being among those aged 35–44 years (17.7%). The proportion of alcohol-attributable deaths among women declined with age, however, similar to men, the absolute number of alcohol-attributable deaths increased with age due to increased mortality (see **Table 4**).

Table 3: Top three causes of alcohol-attributable hospitalisations by age and sex, Scotland 2015.

Age (years)	Condition (men)	N	% of all patients admitted	Condition (women)	N	% of all patients admitted
16–24	Mental and behavioural disorders	422	2.4%	Intentional self-harm	221	0.8%
	Other unintentional injuries	298	1.7%	Ethanol poisoning	220	0.8%
	Fall injuries	196	1.1%	Mental and behavioural disorders	187	0.7%
25–34	Mental and behavioural disorders	711	2.9%	Mental and behavioural disorders	216	0.6%
	Other unintentional injuries	341	1.4%	Other unintentional injuries	191	0.5%
	Fall injuries	211	0.9%	Ethanol poisoning	183	0.5%
35–44	Mental and behavioural disorders	1024	3.6%	Mental and behavioural disorders	417	1.2%
	Other unintentional injuries	302	1.0%	Other unintentional injuries	204	0.6%
	Fall injuries	215	0.7%	Ethanol poisoning	203	0.6%
45–54	Mental and behavioural disorders	1453	3.3%	Mental and behavioural disorders	608	1.2%
	Other unintentional injuries	423	1.0%	Other unintentional injuries	328	0.6%
	Hypertensive diseases	327	0.7%	Ethanol poisoning	238	0.5%
55–64	Mental and behavioural disorders	1248	2.3%	Mental and behavioural disorders	466	0.9%
	Hypertensive diseases	704	1.3%	Other unintentional injuries	315	0.6%
	Alcoholic liver disease	456	0.8%	Fall injuries	275	0.1%
65–74	Mental and behavioural disorders	911	1.5%	Pneumonia	338	0.6%
	Hypertensive diseases	874	1.5%	Hypertensive diseases	295	0.5%
	Cardiac arrhythmias	515	0.9%	Mental and behavioural disorders	290	0.5%

Age (years)	Condition (men)	<i>N</i>	% of all patients admitted	Condition (women)	<i>N</i>	% of all patients admitted
75+	Pneumonia	796	1.2%	Pneumonia	1263	1.5%
	Cardiac arrhythmias	621	1.0%	Fall injuries	520	0.6%
	Hypertensive diseases	532	0.8%	Other unintentional injuries	382	0.4%

Note:

- *N* = The number of patients admitted to hospital with an alcohol-attributable condition in 2015.
- The denominator is the total number of patients admitted at least once in 2015 for each respective sex-age grouping.

Table 4: Number of age- and sex-specific alcohol-attributable deaths in each age group and percentage of all deaths in 2015.

Age (years)	Men <i>N</i> (%) of alcohol-attributable deaths	Men Total number of deaths	Women <i>N</i> (%) of alcohol-attributable deaths	Women Total number of deaths	All <i>N</i> (%) of alcohol-attributable deaths	All Total number of deaths
16–24	32 (20.6%)	155	6 (10.7%)	56	38 (18.0%)	211
25–34	87 (22.1%)	393	30 (15.4%)	195	117 (19.9%)	588
35–44	156 (21.2%)	736	77 (17.7%)	434	233 (19.9%)	1,170
45–54	338 (20.7%)	1,629	176 (15.5%)	1,139	514 (18.6%)	2,768
55–64	451 (14.4%)	3,125	215 (10.3%)	2,083	667 (12.8%)	5,208
65–74	550 (8.9%)	6,209	239 (5.2%)	4,582	789 (7.3%)	10,791
75+	706 (4.6%)	15,509	639 (3.0%)	21,082	1,346 (3.7%)	36,591
Total	2,321 (8.4%)	27,756	1,384 (4.7%)	29,571	3,705 (6.5%)	57,327

Note: Individual values may not sum to total due to rounding.

The largest contributor to alcohol-attributable deaths among men in 2015 was from malignant neoplasms (744 deaths or 2.7% of all deaths in men in 2015; **Figure 7**). The largest contributor to alcohol-attributable death for women in 2015 was from digestive diseases (309 deaths or 1% of all female deaths in 2015) followed closely by malignant neoplasms (304 deaths or 1% of all deaths in women; **Figure 8**).^h See the supplementary appendix.

^h The total for each disease grouping may not sum to the total of the conditions included within it due to rounding. The total for digestive diseases in Figure 7 includes the deduction of 1 death due to the inverse relationship between alcohol consumption and gallstones.

Figure 7: Alcohol deaths in men, 2015

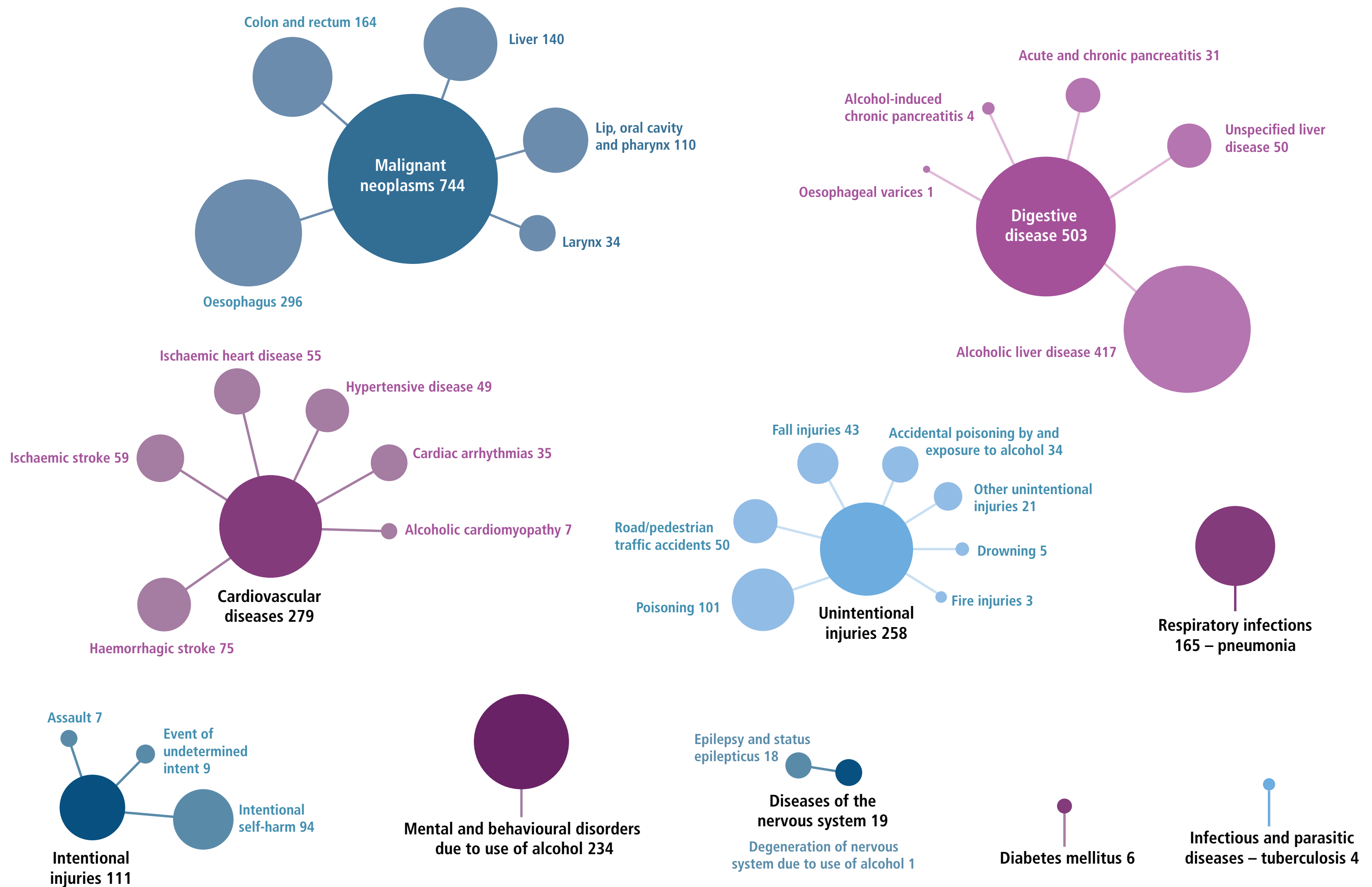
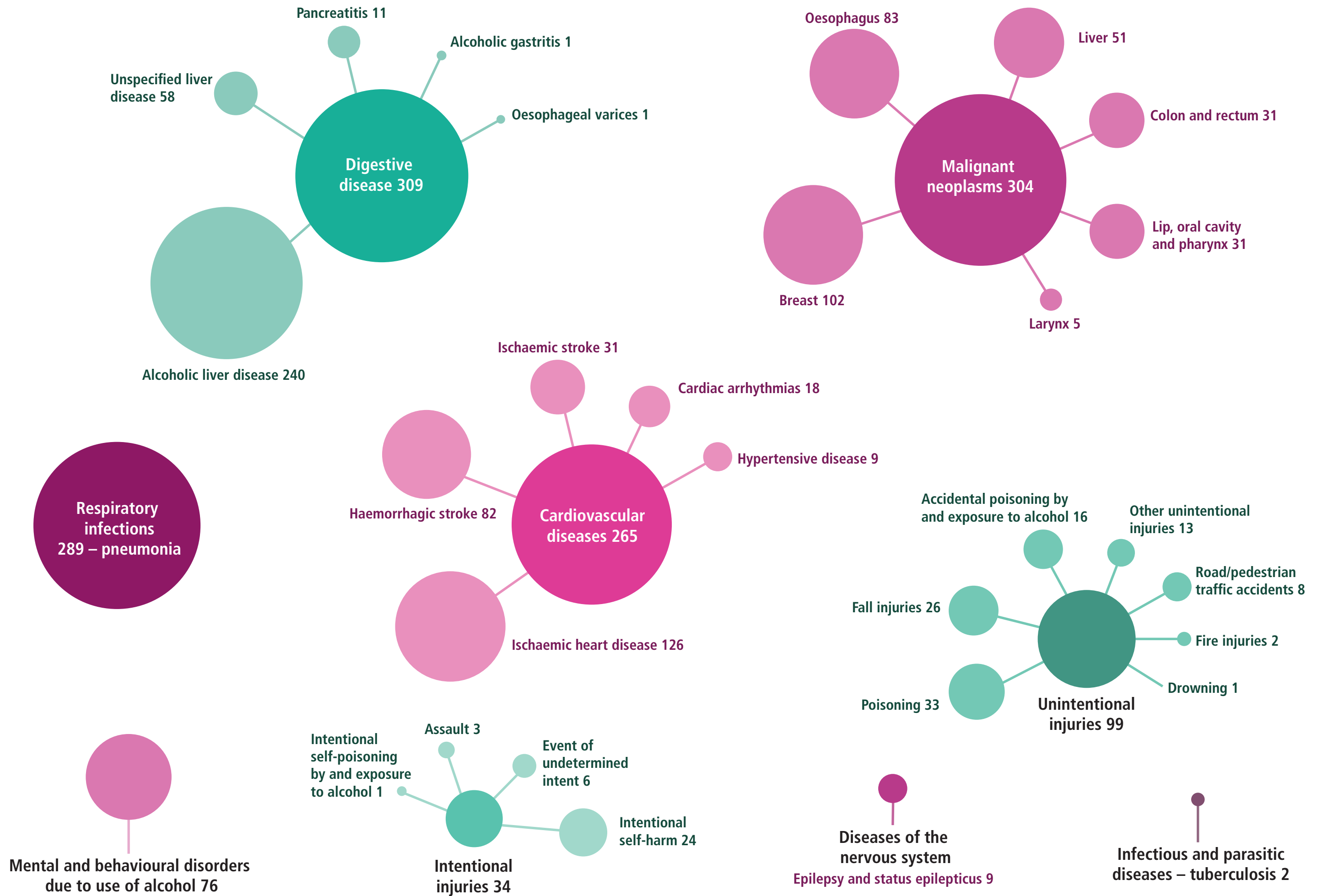


Figure 8: Alcohol deaths in women, 2015



The most common alcohol-attributable cause of death among men aged 16–24 years was intentional self-harm (12 deaths out of 155 total deaths) and among men aged 25–34 years it was poisoning (26 deaths out of 393 total deaths) (see **Table 5**). In men aged 35–64 years the most common alcohol-attributable cause of death was for alcoholic liver disease (288 deaths out of 5,490 total deaths). Neoplasm of the oesophagus was the most common contributor to alcohol-attributable deaths in men aged 65–74 years (102 deaths out of 6,209 total deaths) followed by pneumonia for men aged 75 years and over (136 deaths out of 15,509 total deaths).

The number of alcohol-attributable deaths in women aged 16–34 years of age was small (23 out of 251 total deaths) and these were caused by alcohol-attributable injuries, epilepsy and alcoholic liver disease. Among women aged 35–74 years the most common alcohol-attributable cause was alcoholic liver disease (221 deaths out of 8,238 total deaths). Pneumonia was the most common cause of alcohol-attributable death in women aged 75 years and over (267 deaths out of 21,082 total deaths) (see **Table 5**).

Table 5: Top three causes of alcohol-attributable deaths by age and sex in Scotland 2015, as a percentage of all deaths in each age group.

Age	Condition (men)	N	%	Condition (women)	N	%
16–24	Intentional self-harm	12	7.7%	Intentional self-harm	2	3.6%
	Road/pedestrian traffic accidents	9	5.8%	Road/pedestrian traffic accidents	2	3.6%
	Poisoning	7	4.5%	Poisoning, and epilepsy and status epilepticus	1	1.8%
25–34	Poisoning	26	6.6%	Poisoning	7	3.6%
	Intentional self-harm	20	5.1%	Alcoholic liver disease	7	3.6%
	Road/pedestrian traffic accidents	13	3.3%	Intentional self-harm	4	2.1%
35–44	Alcoholic liver disease	36	4.9%	Alcoholic liver disease	26	6.0%
	Poisoning	35	4.8%	Poisoning	13	3.0%
	Intentional self-harm	23	3.1%	Mental and behavioural disorders	11	2.5%
45–54	Alcoholic liver disease	113	6.9%	Alcoholic liver disease	74	6.5%
	Mental and behavioural disorders	65	4.0%	Neoplasm of breast	21	1.8%
	Neoplasm of oesophagus, and poisoning	23	1.4%	Mental and behavioural disorders	19	1.7%
55–64	Alcoholic liver disease	139	4.4%	Alcoholic liver disease	76	3.6%
	Neoplasm of oesophagus	66	2.1%	Mental and behavioural disorders	23	1.1%
	Mental and behavioural disorders	57	1.8%	Neoplasm of breast	23	1.1%
65–74	Neoplasm of the oesophagus	102	1.6%	Alcoholic liver disease	45	1.0%
	Alcoholic liver disease	92	1.5%	Neoplasm of breast	27	0.6%
	Mental and behavioural disorders	61	1.0%	Neoplasm of oesophagus	25	0.5%

Age	Condition (men)	<i>N</i>	%	Condition (women)	<i>N</i>	%
75+	Pneumonia	136	0.9%	Pneumonia	267	1.3%
	Neoplasm of oesophagus	102	0.7%	Ischaemic heart disease	106	0.5%
	Neoplasm of colon and rectum	83	0.5%	Neoplasm of oesophagus	38	0.2%

Note:

- *N* = The number of deaths in calendar year 2015.
- The denominator is the total number of deaths in 2015 for each respective sex–age grouping.

Overall burden of disease attributable to alcohol

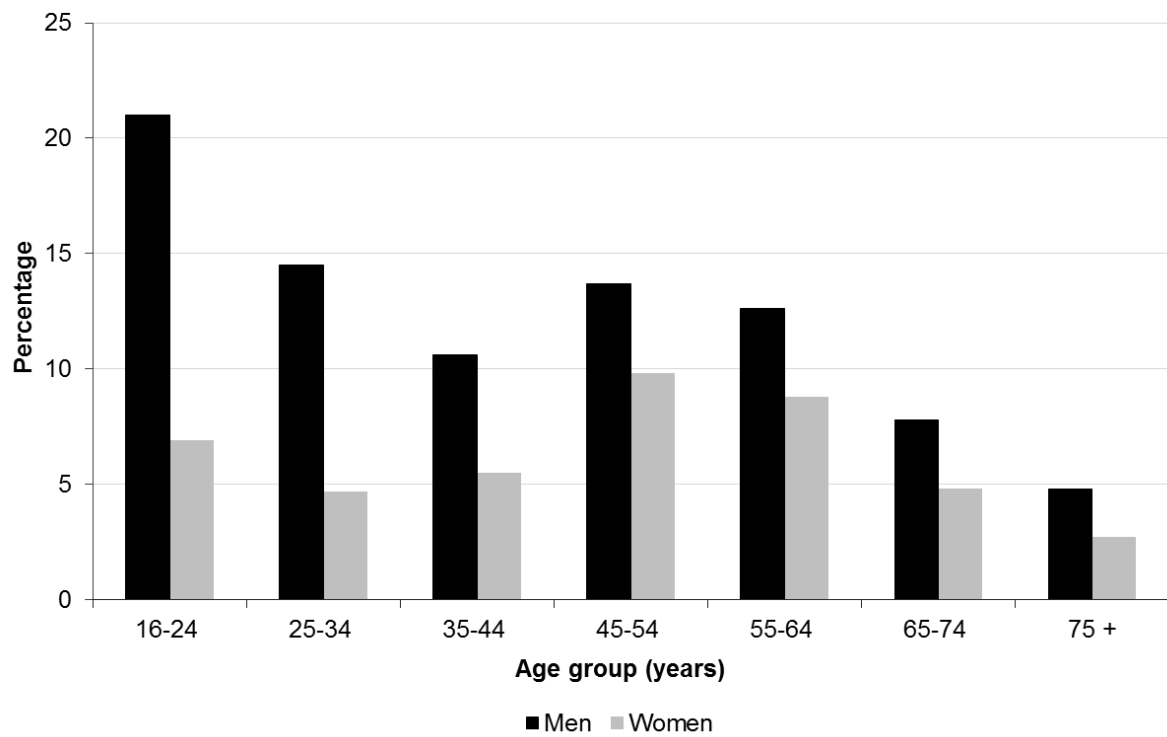
Alcohol consumption accounted for 8.0% of the burden of disease in Scotland in 2015 (104,573 out of a total 1,315,087 DALYs).

Overall, the total number of years lost to death or disability that were attributable to alcohol was higher for men than women, accounting for one in 10 DALYs in men aged 16 years and over and just under one in 18 DALYs in women (see **Table 6**). The absolute burden of disease attributable to alcohol consumption was highest in men aged 55–64 years (14,521 DALYs) but was proportionally highest in men aged 16–24 years of age, with alcohol consumption explaining 21% of DALYs in this age group. The absolute alcohol-attributable burden for women was highest in those aged 45–54 years (9,509 DALYs). The percentage of DALYs attributable to alcohol consumption was higher for men than women across all age groups (see **Figure 9**).

Table 6: Number of alcohol-attributable DALYs in each age group and percentage of all DALYs in 2015.

Age (years)	Men <i>N</i> (%) of alcohol-attributable DALYs	Men Total DALYs	Women <i>N</i> (%) of alcohol-attributable DALYs	Women Total DALYs	All <i>N</i> (%) of alcohol-attributable DALYs	All Total DALYs
16–24	7,016 (21.0%)	33,458	2,201 (6.9%)	31,950	9,217 (14.1%)	65,408
25–34	7,192 (14.5%)	49,603	2,309 (4.7%)	49,223	9,501 (9.6%)	98,826
35–44	6,891 (10.6%)	65,266	3,584 (5.5%)	65,011	10,475 (8.0%)	130,277
45–54	13,298 (13.7%)	96,771	9,509 (9.8%)	97,341	22,807 (11.7%)	194,112
55–64	14,521 (12.6%)	115,213	9,082 (8.8%)	103,744	23,603 (10.8%)	218,957
65–74	10,392 (7.8%)	133,042	5,896 (4.8%)	122,776	16,288 (6.4%)	255,818
75+	7,099 (4.8%)	146,431	5,583 (2.7%)	205,258	12,682 (3.6%)	351,689
Total	66,409 (10.4%)	639,784	38,164 (5.7%)	675,303	104,573 (8.0%)	1,315,087

Figure 9: Percentage of all DALYs that were attributable to alcohol in Scotland 2015, by sex and age group.



Discussion

Main findings

There were 41,161 adults admitted to hospital at least once in 2015 with an alcohol-attributable condition (6.4% of 644,574 patients admitted in total). Of these, one in three patients were admitted due to wholly attributable conditions. Twice as many men as women were admitted to hospital due to an alcohol-attributable cause (8.8% and 4.3%, respectively). There were 3,705 alcohol-attributable deaths among adults in 2015 (6.5% of 57,327 total adult deaths). The contribution of alcohol to death was also greater for men than women with 8.4% of all deaths attributable to alcohol compared with 4.7% of all deaths in women. The overall burden of disease in Scotland in 2015 equated to approximately 1,315,087 DALYs for adults due to premature death or living with disease or injury. Of this, 8% of DALYs were attributable to alcohol consumption (104,573 DALYs) in 2015.

Of the 50 conditions considered in this study, each was grouped into nine higher-level categories of disease and injury. Of those adult patients admitted to hospital for an alcohol-attributable cause in one of these groups, more than one in four (27%) were due to an unintentional injury (11,068 patients admitted out of 41,160 total patients admitted with an alcohol-attributable cause). Of the deaths due to an alcohol-attributable cause in 2015, more than one in four (28%) were caused by cancer (1,048 deaths out of 3,705 total alcohol-attributable deaths).

Strengths and limitations

We aimed to address several common limitations with studies of this type. Self-reported survey data are well known to under-report alcohol consumption levels.^{2,6,8} To mitigate this, the coverage rate for the Scottish Health Survey 2015 data was used to triangulate self-reported survey data with alcohol sales data¹ adjusting consumption to a more realistic level.^{4,8} The impact of this correction on AAF estimates varied by disease but was broadly greater for men than women, e.g. unspecified liver disease had a 25.8% difference between original and adjusted AAFs for men and a 9.8% difference for women.

We used a continuous measure of alcohol consumption (fine gradations in 0.1 g increments) rather than a categorical approach to estimate AAFs. This is a strength over the categorical approach as it increases the power to detect a relationship between the exposure and outcome, reduces the potential to over-simplify the relationship between exposure and outcome, and avoids the masking of any non-linearity between the two variables.¹³

We accounted for changes in alcohol consumption among pregnant women by following the approach taken by Jones and Bellis⁴ who used the 2010 Infant Feeding Survey¹⁴ findings as the basis for re-allocating 49% of current drinkers to former drinkers. It is difficult, however, to say the degree to which this will impact consumption estimates and therefore AAFs.

Quantifying the impact of alcohol consumption on health can be difficult due to limitations in the measures available. Patients admitted to hospital, for example, only captures those individuals where the effects of alcohol are serious enough to warrant hospital admission. This study sought to mitigate this by including a measure called the DALY. This measure combines years of healthy life lost from mild to severe consequential health loss due to alcohol dependence, with the potential years of life lost through premature mortality due to alcohol dependence. Individuals suffering mild to severe health loss were estimated by extrapolating the sex-specific survey point-prevalence estimates of respondents who scored 16 or more on the AUDIT (Alcohol Use Disorders Identification Test) question of the Scottish Health Survey to the adult population of Scotland.¹⁵

We incorporated age- and sex-specific alcohol consumption estimates from the Scottish Health Survey 2015. Although sex-specific RR estimates were used where possible, age-specific RRs were not available. This therefore assumes that the RR is constant across the life course and any departures from this assumption will have the effect of over- or under-estimating the risk for some age groups.

The strength of evidence for a causal link between alcohol consumption and each of the conditions included in this study varied in terms of the strength and direction of the

association, the consistency of the findings among studies and the specificity of the association. For example, the RR functions were not always distinguishable in terms of health outcome (mortality or morbidity). The conditions included do, however, reflect the available evidence and are documented in other similar studies.^{2,4,9}

As well as the effect of average alcohol consumption on health, patterns of alcohol consumption are known to influence the alcohol-attributable burden of disease.² There is evidence of the importance of patterns of consumption for diseases such as liver cirrhosis, ischaemic heart disease and acute injuries.¹⁶ Approaches have been developed to account for drinking patterns in the calculation of AAFs. However, it was not possible to include estimates of drinking patterns for the partially attributable conditions in this study due to a lack of data on the frequency of binge drinking in Scotland. This is likely to underestimate the impact of alcohol on the alcohol-attributable burden of disease.

Estimates of the consumption of alcohol in 2015 were applied to the number of patients admitted to hospital and deaths in 2015. While this may be reasonable in the case of injuries where the acute effects of alcohol lead to injury or death, it is an oversimplification for chronic diseases which reflect historical alcohol consumption patterns.⁷ Given that the trend in alcohol sales, a good proxy of consumption, has shown some fluctuation over the last decade, this creates a level of uncertainty around the proportion of mortality and morbidity attributable to alcohol. This study may underestimate the impact of alcohol in the case of a heavy drinker who has recently stopped or reduced their alcohol intake or over-estimate the risk in the case where someone has recently increased their intake. There was also a greater degree of uncertainty around the AAF estimates for pregnancy-related conditions, due to difficulties in obtaining robust estimates of alcohol consumption data among pregnant women.

The ONS revised definition of alcohol-specific (wholly attributable) deaths¹⁷ was not available when this analysis was carried out. We therefore took the decision to base our cause list on the most recent available work of Jones and Bellis who did a similar analysis for England.⁴ This study therefore considers five conditions over and above the ONS definition (these are: ethanol poisoning, evidence of alcohol involvement by blood

alcohol level, evidence of alcohol involvement by level of intoxication, methanol poisoning and toxic effect of alcohol, unspecified). The different definitions had no impact on alcohol-attributable deaths as there were no deaths for any of these five conditions in 2015. When applied to hospitalisation data, there were an additional 2,022 patients admitted to hospital in 2015 for the five conditions mentioned above.

Estimates of patients hospitalised for mental and behavioural disorders due to use of alcohol are based on data for general acute inpatient stays and day cases (SMR01). In order to align with the data sources used to calculate previous estimates, we did not include admissions to psychiatric hospitals (SMR04) and are therefore likely to underestimate the number of patients admitted to hospital in 2015 due to alcohol.

The DALY enabled a more comprehensive measure of the alcohol-attributable burden of disease to be estimated than through hospital admissions and deaths alone; this is due to the inclusion of additional data sources such as the cancer registry. It is, however, still likely to underestimate the real crude number of alcohol-attributable DALYs due to the cross-mapping required of the disease classification from this study with that of the SBoD study. In addition, wholly attributable conditions could not be isolated from the broader SBoD categories for the majority of conditions; this will also result in underestimation.

A measure of uncertainty around future AAF estimates would help provide clarity on the precision of the estimates in the report. However, limited information on the variance of the RR estimates used in this study precluded the calculation of confidence intervals. Future work underway as part of the SBoD study¹⁸ to investigate the potential to use linked data for the calculation of Scottish-specific relative risks may also help with the calculation of confidence intervals.

How this fits with the literature

When the current method was retrospectively applied to 2003 alcohol consumption data from the Scottish Health Survey 2003,¹⁹ AAFs for chronic partially attributable conditions were found to be broadly lower in 2015 than they were in 2003. This is likely to be a reflection of the reduction in average alcohol consumption levels observed since

2003. However, the reductions in AAFs were not observed for all conditions [exceptions being neoplasm of the colon and rectum (men), ischaemic stroke, pneumonia and cholelithiasis].

A negative AAF was calculated for gallstones in both men and women (–2%) and for diabetes in women (–4%) suggesting a mildly protective effect of alcohol in these conditions. The protective effect of alcohol consumption in relation to the development of diabetes mellitus was not evident for men. A protective effect of alcohol consumption in relation to diabetes mellitus is reported in the literature,^{20,21} however, the evidence is mixed, with other studies suggesting that the risk of diabetes may vary with the amount of alcohol consumed, being greatest for those with high alcohol consumption.²²

Conclusions

Alcohol consumption remains an important and substantial cause of deaths, hospital admissions and the overall burden of disease in Scotland. Of particular concern is the contribution of alcohol to deaths from cancer as well as admission to hospital for unintentional injuries. The impact of alcohol consumption on health was generally greater for men than women in 2015 with alcohol-attributable injuries double that of women for two-thirds of the injuries considered in this study.

Preventative action is necessary to reduce alcohol consumption in the general population if long-term improvements in alcohol-attributable harm are to be realised and the pressure on health services eased.

References

- ¹ Giles L, Robinson M. Monitoring and Evaluating Scotland's Alcohol Strategy (MESAS): Monitoring Report 2017. Edinburgh: NHS Health Scotland; 2017. URL: www.healthscotland.scot/publications/mesas-monitoring-report-2017 (accessed 10/12/2017).
- ² Grant I, Springbett A, Graham L. Alcohol attributable mortality and morbidity: alcohol population attributable fractions for Scotland. Edinburgh: ISD Scotland; 2009. URL: www.scotpho.org.uk/downloads/scotphoreports/scotpho090630_alcoholfractions_rep.pdf (accessed 06/08/2017).
- ³ ScotPHO. National Burden of Disease, Injuries and Risk Factors Studies. 2017. URL: www.scotpho.org.uk/comparative-health/burden-of-disease/overview (accessed 21/10/2017).
- ⁴ Jones L, Bellis M. Updating England-specific alcohol-attributable fractions. Centre for Public Health: Liverpool John Moores University; 2014. URL: www.cph.org.uk/wp-content/uploads/2014/03/24892-ALCOHOL-FRACTIONS-REPORT-A4-singles-24.3.14.pdf (accessed 09/10/2017).
- ⁵ Administrative Data Liaison Service. Scottish Health Survey. 2015; URL: www.adls.ac.uk/find-administrative-data/linked-administrative-data/scottish-health- (accessed 1/9/2017).
- ⁶ Catto S. How much are people in Scotland really drinking? A review of data from Scotland's routine national surveys. Public Health Observatory Division, NHS Health Scotland: Glasgow; 2008. URL: www.scotpho.org.uk/publications/reports-and-papers/how-much-are-people-in-scotland-really-drinking-a-review-of-data-from-scotlands-routine-national-surveys (accessed 10/11/2017).
- ⁷ Rehm J, Imtiaz S. A narrative review of alcohol consumption as a risk factor for global burden of disease. Substance Abuse Treatment, Prevention, and Policy 2016;11:37.

⁸ Rehm J, Kehoe T, Gmel G, Stinson F, Grant B, Gmel G. Statistical modeling of volume of alcohol exposure for epidemiological studies of population health: the US example. *Population Health Metrics* 2010;8(1):3.

⁹ Rehm J, Sherk A, Shield K, Gmel G. Risk relations between alcohol use and non-injury causes of death. Centre for Addiction and Mental Health: Toronto; 2017.

¹⁰ Institute for Health Metrics and Evaluation (IHME). GBD Compare Data Visualization. Seattle, WA: IHME, University of Washington, 2016. 2017. URL: (accessed 11/8/2017).

¹¹ World Health Organization. Health statistics and information systems: Quantifying the Burden of Disease from mortality and morbidity. 2015; URL: www.who.int/healthinfo/global_burden_disease/metrics_daly/en (accessed 12/8/2017).

¹² Kelly C, Pashayan N, Munisamy S, Powles J. Mortality attributable to excess adiposity in England and Wales in 2003 and 2015: explorations with a spreadsheet implementation of the Comparative Risk Assessment methodology. *Population Health Metrics* 2009;7:11.

¹³ Altman DG, Royston P. The cost of dichotomising continuous variables. *BMJ British Medical Journal Publishing Group* 2006;332(7549):1080.

¹⁴ McAndrew F, Thompson J, Fellows L, Large A, Speed M, Renfrew M. Infant Feeding Survey 2010. Leeds: Health and Social Care Information Centre; 2012. URL: https://sp.ukdataservice.ac.uk/doc/7281/mrdoc/pdf/7281_ifs-uk-2010_report.pdf (accessed 10/11/2017).

¹⁵ Scottish Burden of Disease, Injuries and Risk Factors Project Team. Scottish Burden of Disease Study, 2015: Alcohol dependence technical overview. 2017. URL: www.scotpho.org.uk/media/1445/sbod2015-alcoholdependence.pdf (accessed 12/8/17).

¹⁶ Rehm J, Greenfield TK, Kerr W. Patterns of drinking and mortality from different diseases — an overview. *Contemporary Drug Problems* 2006;33(2):205-235.

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- ¹⁷ Office for National Statistics. Alcohol-specific deaths in the UK: registered in 2016. 2017; URL: www.ons.gov.uk/peoplepopulationandcommunity/healthandsocialcare/causesofdeath/bulletins/alcoholrelateddeathsintheunitedkingdom/registeredin2016 (accessed 12/11/2017).
- ¹⁸ Scottish Burden of Disease Team. Scottish Burden of Disease Data 2015. 2017. URL: www.scotpho.org.uk/comparative-health/burden-of-disease/sbod-data-2015 (accessed 11/7/2017).
- ¹⁹ Bromley C, Chaudhury M, Craig R, Deverill C, Erens B, Fuller E, et al. Scottish Health Survey 2003. Volume 2: adults. Edinburgh: Scottish Centre for Social Research; 2005.
- ²⁰ Howard AA, Arnsten JH, Gourevitch MN. Effect of alcohol consumption on diabetes mellitus: a systematic review. *Ann Intern Med* 2004;140(3):211–219.
- ²¹ Baliunas DO, Taylor BJ, Irving H, Roerecke M, Patra J, Mohapatra S, et al. Alcohol as a risk factor for type 2 diabetes: A systematic review and meta-analysis. *Diabetes Care* 2009;32(11):2123–2132.
- ²² Cullmann M, Hilding A, Östenson C. Alcohol consumption and risk of pre-diabetes and type 2 diabetes development in a Swedish population. *Diabetic Med* 2012;29(4):441–452.

